AMRAD Newsletter

AMATEUR RADIO RESEARCH AND DEVELOPMENT CORPORATION

P.O. Drawer 6148 *McLean, VA. USA 22106-6148* Vol. XVII - No.1

Calendar

Meetings are normally held on the first Monday of each month at the Red Cross Building in Merrifield Va.

Monday	Mar 5	Meeting
Monday	Apr 2	Meeting
Sat	Apr 7	Cherry Blossom Parade
Sat	Apr 21	Massanutten Mountain Massacre (Old Dominion 50-mile Run)
Monday	May 7	Meeting
Sat-Sun	May 19-20	MS 150K Bike-a-thon
Monday	Jun 4	Meeting
Sat-Sun	Jun 9-10	Old Dominion 100-mile Ride&Run
Monday	Jul 2	Meeting
Monday	Aug 6	Meeting

AMRAD publishes six Newsletter issues a year (on the first weekend of each odd-numbered month). Authors are encouraged to submit copy to the Editor by the first weekend of even months for the next Newsletter. The originals of figures, pictures, or graphics should be directed to the Publisher (Bill Pala) with a copy to the Editor (Deborah Borden).

The President's Ramblings: 1989 in Review

by André Kesteloot N4ICK

As we move into the last decade of this century, it is appropriate to take the time to review our achievements in 1989. (I hope you like this rather novel introduction: "As we move into the last decade etc." I am sure you have never seen it in other publications, and we are glad to be able to grant you its free use for your reports at the office, provided you state you read it in the AMRAD Newsletter.)

But, seriously, what have we achieved?

a) AMRAD has remained alive and well. At a time when many amateur radio groups and projects falter and/or disappear, we have remained constant in number of members and, some would add, in enthusiasm. (Hint: we could do with some new members. Have you, esteemed Reader, recently brought a new member to AMRAD, or simply just a new visitor to one of our technical meetings? We could also do with even more enthusiasm. Do you have any to spare? If so, contact us; we have the projects if you have the interest.)

b) as promised, we have published 6 good issues of the Newsletter in 1989. The Newsletter is the principal link between the core group at AMRAD and the rest of its members at large, and we constantly strive to make the Newsletter a better one. Massive kudos must go to the Newsletter's Publisher, Bill Pala WB4NFB and its Editor, Deborah Borden, for getting the articles lined up on time, negotiating with the Printer, etc. In addition, special mention should be given to the work of Dick Barth W3HWN, who attends all our technical meetings, takes notes, and then somehow manages to produce coherent summaries of the meetings for the Newsletter.

c) our 147.21/81 repeater remained as valiant as ever, and was indeed improved this year. Here our sincere thanks go to Jeff Brennan WB4WLW for his tireless work in keeping the Thing on the air. As a reminder, the AMRAD repeater is open to ALL types of (legal) transmissions (not just voice). Thus if you have some strange modulation scheme in mind, contact us.

d) technical meetings: 1989 saw some very interesting meetings, and we need thank David Borden K8MMO for lining up the various speakers, lecturers and demonstrators. These included:

David Borden K8MMO described the latest developments in Digital Signal Processing, something considered by many as the next frontier in Amateur Radio.

André Kesteloot N4ICK demonstrated his latest: a high speed data modem using spread spectrum technology.

Maitland Bottoms AA4HS described HF modems built by the Navy Research Lab (NRL) and using DSP technology.

André Kesteloot N4ICK gave a summary of recent advances in amateur spread spectrum technology (see also May 1989 QST and July 1989 QEX)

Howard Cunningham WD5DBC demonstrated his latest toy: the portable Apple computer known as the MacLap.

David Borden K8MMO demonstrated the AMRAD-designed DSP board sporting the Motorola 56001 DSP "engine." The board operates as a plug-in into an IBM PC-XT clone.

Maitland Bottoms AA4HS explained many of the finer points of the new Motorola Debugger.

Maitland Bottoms also presented "Digital Signal Processing, an Introduction." (Maitland is involved in DSP during daytime, and claims to make a living of it!)

Hal Feinstein WB3KDU gave a 15 minute tutorial in "ROUTING" (as in: sending a message from point A to point F)

André Kesteloot N4ICK demonstrated his latest design, a analog-to-digital interface card for the IBM PC-XT compatible

Bill Sachs KM4DN discussed audio processors for radio applications, and demonstrated a remarkable voice processor he has designed for ham-radio applications.

Howard Cunningham WD5DBC gave a practical demonstration of the NEXT computer, and all of you had an opportunity to touch this incredible machine!

e) in 1989, articles based on development performed under AMRAD auspices, appeared in QST, QEX and 73 Magazine. These articles covered different aspects of spread-spectrum technology. For 1990, we already have two articles lined up for publication in QEX, one by David Borden, the other one by yours truly, both on Digital Signal Processing. These articles are important for many reasons, not the least of which is that they tell the rest of the Amateur Radio world of the work performed by AMRAD. Many of our most recent members in fact decided to join AMRAD after they read such articles.

f) several AMRAD members (in particular David Borden K8MMO, Terry Fox WB4JFI and John Teller N4NUN) have worked very hard to develop a prototype DSP plug-in card for the IBM PC and its clones, and some software to drive it. This card has been demonstrated at several AMRAD meetings and should be a source of pride and joy for its parents. We at AMRAD perceive DSP as a potentially extremely useful addition to the existing tools of the Average Ham Operator. (Incidentally, did you see the latest advertisement in Popular Mechanics, Feb 1990, page 110, for the Escort radar detector, sporting a Motorola 56000 DSP chip? Progress never ceases!)

g) The HEX telephone bulletin board for the handicapped,(under the management of Dick Barth W3HWN) and the regular AMRAD BBS (under the supervision of Lawrence Kesteloot N4NTL) were kept in operation 24 hours a day. (Some of you may never have considered how much time and efforts are involved in running a BBS: cleaning up messages, checking recent uploads, deleting unsuitable material etc. To Dick and Lawrence, our thanks for their dedication.)

h) AMRAD is also investigating a DF system for short burst transmissions, such as those of the new ELT system (500 milliseconds long every 50 seconds on 406.025 MHz). Here most of the work and coordination were carried out by Glenn Baumgartner KA0ESA, Dave Rogers N4GJQ and yours truly with the help of Elton Sanders WB5MMB.

i) our thanks also go to Gerald Adkins N4GA, our Treasurer who keeps our finances on the straight and narrow path, and to all of you, dear Readers, who help our Treasurer by sending in your renewal and/or membership fees!

Keep up the good work! AMRAD, with a little help from each of you, will have a great 1990. 73 De André N4ICK.

Presentations at the November 1989 AMRAD Meeting

A Synopsis

by Dick Barth, W3HWN

The evening began with Jeff Brennan, WB4WLW, showing a transceiver he had just spent about forty hours putting together. It is to be used in the a AMRAD repeater which Jeff maintains, so its regulated power supply includes an RFI filter. It was assembled out of Hamtronics boards. The receiver has its own de-emphasis and audio amplifier. A tap off the discriminator output is fed into a separate de-emphasis circuit, with care taken to keep the de-emphasis circuit high impedance in order to preserve fidelity. The original discriminator output was loaded down by the audio amp, so its curves were distorted.

Jeff incorporated a solid state T/R switch; no mechanical relays are used. Carrier detect in the receiver fires a transistor pair to bring up the transmitter. The mixer stage was modified to use a dual-gate GaAsFET and other stages were altered as well.

This rig will be used as a remote input to the two-meter repeater. The two meter receiver will key the 440 Mhz transmitter which talks to a voting circuit at the Tyson's Corner repeater site.

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David Borden, K8MMO, next updated the group on the DSP board he and other members have been working on. This board was designed by Terry Fox and wired largely by John Teller with additional work being done by Dave. Since last month the host interface has been made to work in polled mode. Yet to come are operation in interrupt mode and DMA mode. The D/A converter appears to be functional, although it hasn't yet been fully tested.

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Bill Sachs, KM4DN, a professional audio engineer, next presented a demonstration of speech processing and its application to amateur radio. The entire presentation was miked, fed into a PA system, and transmitted (into a dummy load) with a two meter HT so that attendees could see the effect of processing on the signal.

FM ham gear does not normally include standard EIA pre- and de-emphasis. EIA specifies a 3 KHz turnover frequency, while ARRL handbook recommends 75 microseconds, providing a turnover of 2 KHz. The commercial stuff (Motrac conversions, etc.) use EIA curves and thus do not provide compatibility with normal ham gear. While not obvious to people who aren't looking for it, the difference can have an adverse effect on intelligibility under poor conditions.

EIA pre-emphasis standards were established because of the common use of phase modulation rather than true FM modulation in transmitters. The curves tend to compensate for the fact that phase modulation can do strange things to non-sinusoidal input signals.

High frequency energy in the audio increases the bandwidth of the transmitted signal. The energy of the human voice decreases at frequencies above 1 KHz, while the high-frequency energy content of noise is quite high. Pre- and de-emphasis increases the level of higher voice fre-

quencies before modulation and reduce it after detection. This leaves the energy distribution of the voice unchanged, but reduces the effect of noise.

Companding is a noise-reduction process which involves compressing a signal before modulation and then expanding it after detection. This results in the mod-demod process having to handle a smaller dynamic range and results in better audio quality and higher audio levels at the output. Some chips have been developed in the audio business which make companding a reasonable project for hams.

A peak limiter transmitter is not widely used in ham radio transmitters but gives you about ten dB better audio on the average. Bill has tried to use heavy compression but the results have not been appreciated by his listeners. Since the peak-to-average ratio of the voice can be over twenty dB, something must be done to reduce it if maximum intelligibility is to be maintained. Clipping combined with light companding appears to be the answer.

Double-blind studies of listeners have shown that clipping can be done without being obvious if the frequencies being clipped and the time duration under the clipper are right. If clipping time is limited to ten milliseconds or so, chances are nobody will notice. Bill has set the attack time on his limiter to about 2.5 ms, which increases his average speech power by about five or six dB.

A commercial companding system something like DBX might be appropriate. The patent owners of the chips used to implement this system were approached and appear willing to cooperate. A mild form of compression (between 10 and 15 dB) should provide a useful improvement. This amount of compression would be compatible with non-expanding receivers, in that the compression on the signal is noticeable but not objectionable. Compression could thus be phased in over a period of years without disadvantaging users of current equipment.

Next came Bill's explanation and demo of a "pressure zone microphone". Many hams use an electret (electrostatic) microphone, the type used in many handi-talkies. It is conveniently small and has reasonable bandwidth and sensitivity. In ham equipment the element is most often used by simply talking into the front of it. This is called a "free space" application.

There is a boundary zone that extends a tenth or twentieth of an inch above a hard surface. This zone lacks the comb-filtering effect of multiple reflections produced when a sound wave bounces off walls, ceilings, floors and furniture. Pointing the microphone directly at the hard surface and placing it within the boundary zone produces higher gain, cleaner audio and better bass response. An ordinary business card has about the right thickness to be used for spacing the mike from the surface.

Chip Fetrow, N4QFW, broadcast engineer and formerly chief engineer at WAVA, pointed out that at one time he had done considerable research into the performance of various types of microphone. It covered everything from units listing at $1400 a copy, down to Radio Shack electret elements costing a dollar a piece. It turned out that the best mike of all those tested was the expensive brand - no surprise there - but second best was a Radio Shack element. The rest of the pack were not even close.

The Shack has two electret units at this writing, one selling for 99 cents and another for $1.49. Prices may vary, of course. The better unit was the one without a separate power lead, which is catalog number 270-090 and cost the writer $1.49. The less expensive unit has a separate power lead but doesn't perform as well.

Placing the element at the intersection of two boundaries (such as in the corner of a room) produces additional gain. Pointing the element at a flat surface gives you 6 dB; putting it in a corner gives 12 dB. The plane used does not have to be as big as a wall, however. Changing the size of the plate varies the bass response of the microphone system. A plate two feet square has a usable frequency response down to eighty Hertz. One unit displayed at the meeting consisted of a sheet of plastic under eight inches square which is adequate for voice. A smaller unit of about four by four extends response down to 300 Hertz. The microphone used by the speaker for mobile operation consists of two elements in front of a common plate. The two hot leads are fed into a differential amplifier to provide noise cancellation.

The high frequency response is affected by the distance of the mike element from the boundary. Moving it closer creates a 12 dB per octave roll-off of the highs, which can be used to control sound brilliance and feedback where needed.

The pressure zone extends in both directions from the boundary; a microphone mounted in a hole in the wall, recessed a tenth of an inch behind the surface, will provide the advantages of a pressure zone microphone.

The PZM was invented by a ham; its patents are owned by Crown so commercial exploitation of the idea is restricted although personal use is not objectionable, according to the speaker.

References: Handbook for Sound Engineers, (about $80)
Sound Systems Engineering, by Don Davis
IC Op Amp Audio Applications by Walt Johnson, 3rd Ed.

Howard Cunningham, WB5DBC, did a show-and-tell of a MacIntosh portable. Since it needed repair, a demonstration wasn't possible.

Thanks For The Contributions

AMRAD would like to acknowledge recent contributions toward the operation of the Handicapped Educational Exchange received from Debra Ann Salo of Seattle WA and Ron Hopley of Andover MA.

Such donations are always welcome and are tax deductible, since AMRAD is a tax-exempt educational organization operating under 501(c)(3) of the Internal Revenue Code.

Presentations at the December 1989 AMRAD Meeting

A Synopsis

by Dick Barth, W3HWN

As usual, December brought the annual business meeting, at which AMRAD members elect successors for those directors whose terms are due to expire. The meeting began with an introduction by the club president, André Kesteloot, who thanked some of those whose efforts had kept the club going over the past year. These included the editor (Deborah Borden) and publisher (Bill Pala) of the newsletter, the club officers, and the various techies and hackers whose efforts provide functioning repeaters, grist for the newsletter, presentations for the meetings, a *raison d'être* for the club, and a means of keeping AMRAD on the map.

Balloting resulted in the election as AMRAD Directors of Dave Borden, K8MMO; Terry Fox, WB4JFI; and Elton "Sandy" Sanders, WB5MMB. Jeff Brennan, WB4WLW and John Teller, N4NUN and were elected alternates.

Following business discussions, there were a couple of brief show-and-tell operations by some of the regulars. Terry Fox showed and talked about the DSP board he has designed to plug into the IBM-PC bus. It has been described previously in the AMRAD newsletter. It uses a 56001 DSP chip, four banks of memory currently holding 8Kx8, a serial loader, three timers, A/D and D/A converters and various kinds of glue.

It was mentioned that the current issue of BYTE magazine discusses amateur packet radio, its history and current status. AMRAD is mentioned.

Howard Cunningham, who currently works for a large computer dealer, next demonstrated a NEXT computer. This is the machine put together by Steve Jobs after he left Apple Computer. It's a 63030-based box running at about 25 MHz. It has a built-in 56001 DSP chip. The version shown had a built-in optical drive with 260 megabytes capacity and 92 millisecond access time. Newer models have bootable 40 meg hard drives. The operating system is a version of UNIX. Display resolution is 1120x832 pixels compared to 640x320 for the standard IBM-PC.

Random Technical Thoughts

by André Kesteloot N4ICK

An Audio Activity Indicator

Suppose you have mounted several radio receivers (say 2 Meters, HF, 440 etc.) or simply several speakers, in the same space (rack, automobile dash board, etc) and you monitor them all at the same time, how do you determine which one just blared your call-sign? By using the famous AMRAD Audio Activity Indicator. This is a nifty gadget, designed at great cost in our research laboratories but easily built in a few minutes in the privacy of your own home. Referring to figure 1, the circuit connects directly across the speaker terminals of each radio, via a shielded cable. This audio is amplified and clipped by one of the four amplifiers contained in a TL084, then fed to 1/4 of a LM339 comparator, the output of which drives an LED into conduction. The TL084 is configured for a gain of 100 (thus insuring plenty of drive to the next stage), and the bias circuit of pin 4 of the LM339 is such that any signal at pin 5 larger than 0.3 volts will drive the LED. Take great care of decouplings and heavy gage ground returns, so that one amplifier will not be triggered by circulating LED currents of the other ones. The whole circuit fits easily on a small Radio Shack board (RS 276-150) and allows for the output of four different radios to be monitored at the same time. Total cost if you buy all parts new: less than $5 or $1.25 per channel. You can afford to be daring, and add more blinking lights to your shack!

A Wideband Voltage-Controlled Oscillator

A wideband VCO is not usually an easy circuit to design. (Of course you can use the ubiquitous MC1648, but you are limited by the LC ratio.) The other day, looking up something else in the Motorola High-Speed CMOS Logic Data Book, I noticed that the propagation delay of the 74HC02 Quad 2-input NAND gate varies from 45 nanoSec at Vcc = 2 volts, down to 8 nanoSec when Vcc = 6 volts. It seemed to be worth investigating as the basis for a low frequency VCO. Looking at my schematic (figure 2), you will notice that I have connected in series three sections of U2, a 74HC02 , while the fourth section is connected as a buffer. The Vcc of U2 is derived from Q1, a separate series regulator whose output voltage can be controlled remotely. The output of U2 pin 13 is a square wave, the frequency of which varies from 1 MHz to 7.8 MHz when the Vcc of U2 is varied from O volt (Gnd) to +5.8 volts DC. Since the frequency variation is obtained by varying the voltage applied to the whole IC, the output amplitude at U2 pin 13 varies too, from approximately 2 volts to 5.5 volts peak-to-peak. This signal now drives U3a, 1/6th of a 74HC04 Hex Inverter, configured as a linear amplifier (by connecting a 100K Ohm resistor from its output back to its input) which in turn drives U3b, another inverter/buffer. Finally Q2, a 2N2222, is used as a low impedance line-driver.

The 74HC series can be used with Vcc as high as 6 volts, and I thus increased the output of U1, a 7805 regulator, to 5.8 volts, by inserting diode D2 in series with the ground pin of U1. Without that diode, the output frequency range will be from 500 KHz to 6.5 MHz. (D1 is a protection diode,

which prevents destroying the whole circuit if you accidentally reverse the DC input wires. Incidentally, you can replace the three sections of the 74HC02 by five sections of a 74HC04 for a different output frequency range.)

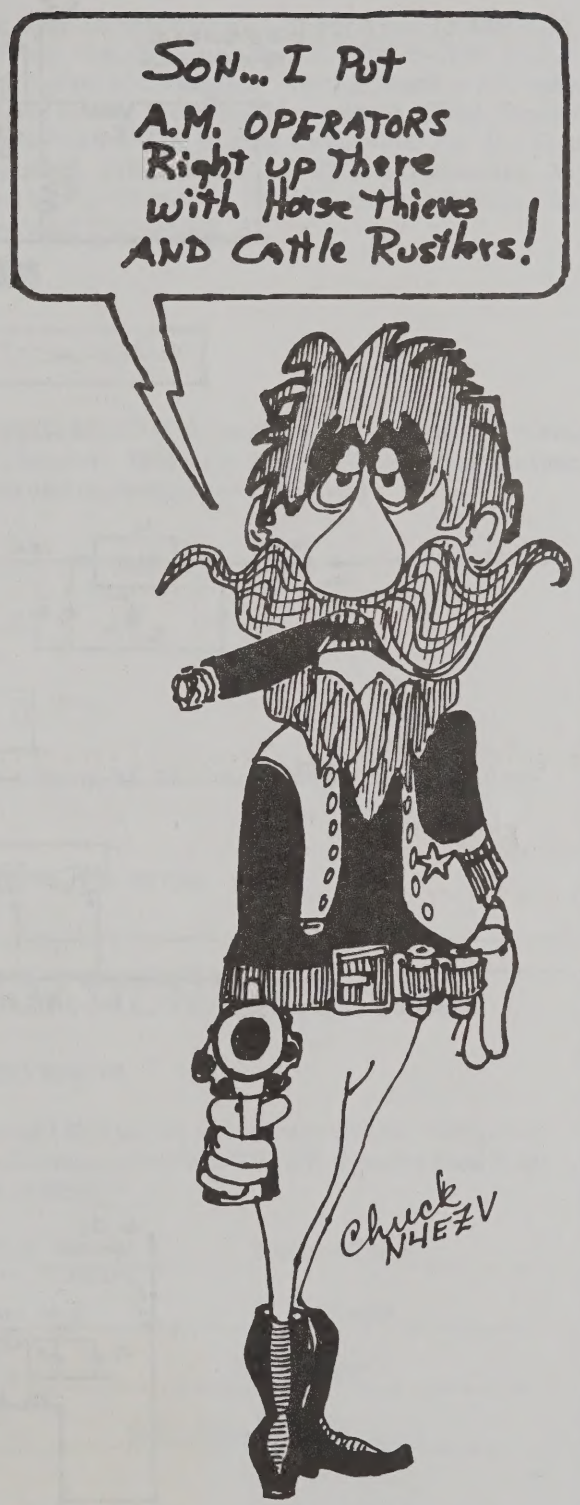
Adjustments are simple: connect a oscilloscope or a frequency counter to the output. Temporarily ground the control voltage line, and adjust the potentiometer which determines the base voltage of Q1 until a 1 MHz output frequency is obtained. Now connect the control input to +6 volts (U1 out) and notice that the output frequency goes to approximately 7.8 MHz. The control current required from the outside world never exceeds 400 uA, and can thus be supplied by any phase comparator. (One use for this circuit is a wideband FM oscillator.)

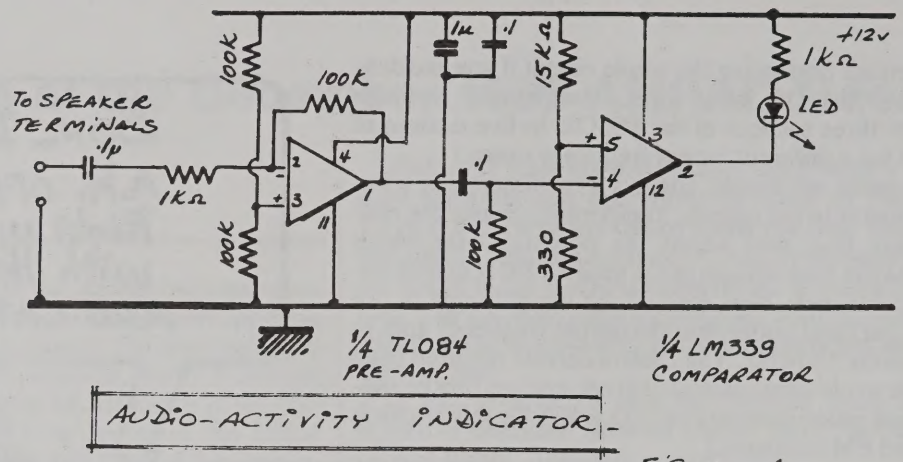
Frequency Synthesizer:

In the AMRAD Newsletter for November 1988 and in QEX for July 1989, I described a transmitted-reference spread spectrum system using two synthesized oscillators. It was highly tempting to combine the VCO described above and the synthesizer circuit described in QEX. Here it is. Looking at figure 3, the output of the VCO just described is fed to a Motorola MC145151 which includes a divider by R and a divider by N. The R dividing ratio can be selected to obtain the desired frequency steps (In this case I have used a 5.120 MHz crystal, which, when divided by 1,024, produces 5KHz steps.) The N divider has a division ratio adjustable from 3 to 16,383 depending on the position of several dip switches. The contraption works like a charm. (If you want smaller steps, you may want to use a lower frequency crystal, or a larger division ratio for the R divider.) To obtain an output frequency of 6MHz, for instance, the needed dividing ratio for the divider-by-N is 6,000,000 (the desired output frequency) divided by 5,000 (the reference frequency at the phase comparator) or 1,200. Now 1,200 = 1,024 + 512 + 256 + 128 + 64 + 16 and the corresponding bits 10,9,8,7,6 and 4 must therefore be set. Since all the bits are normally set by pull-up resistors connected internally to +Vcc in the MC145151, you will have to ground, by means of the dip-switches, all the bits not mentioned above, i.e. bits 13,12,11,5,3,2,1 and 0.

New Ideas:

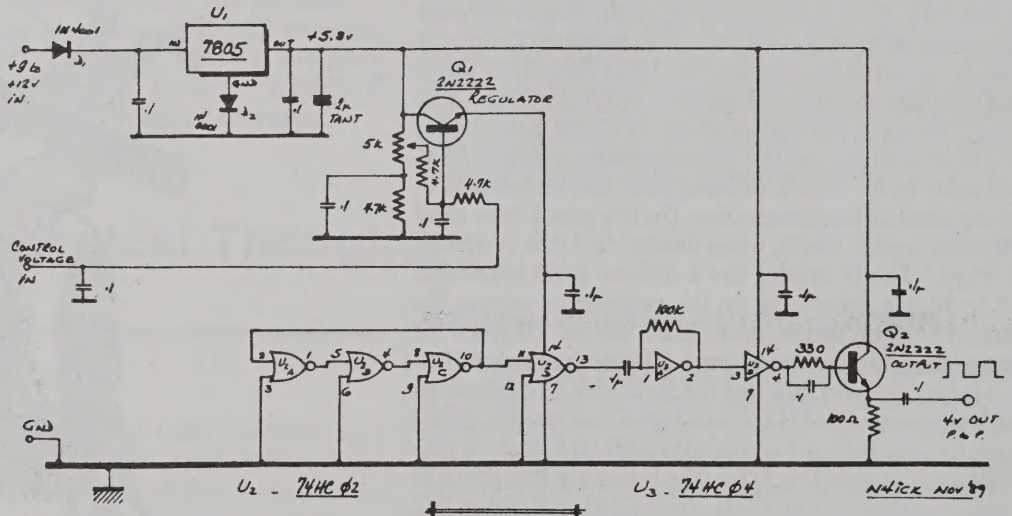
Incidentally, if you built something recently, no matter how simple, different, useless, crazy, etc, why not submit it for publication? (You can even sketch it on the back of an envelope; our trained staff will promptly redraw it to our exacting standards.) And remember, if your article is published, you will receive a free one-year membership; Fame and Early Retirement are finally within your grasp. (And, in the process of spreading your technical ideas, you will help the Amateur Radio community. Consider that one of the stated purposes of Amateur Radio is to advance the state of the technology, and that talking into your Japanese-made hand-held about a traffic jam, on the way back from work, does *not* advance the state-of-the-art. Am I showing some bias towards "techie" work? You bet I am !).





AUDIO-ACTIVITY INDICATOR

FIGURE 1



1-8 MHz VCO

FIGURE 2.

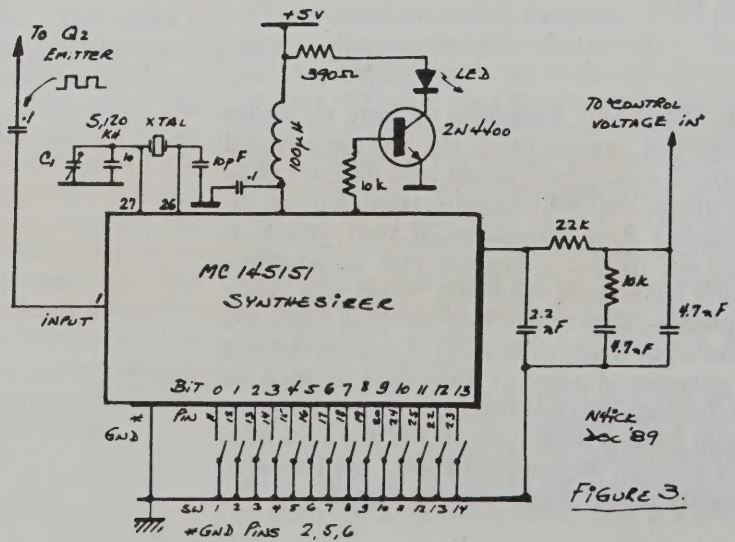


FIGURE 3.

AMRAD ANNUAL REPORT FOR 1989

U.S. Postal Service Statement of Ownership, Management and Circulation (Required by 39 U.S.C. 3685):

1A.)Title of Publication: AMRAD Newsletter; 1B.)Publication Number: none; 2)Date of Filing: Non-Profit no filing; 3)Frequency of Issue: Bi-monthly; 3A)Number of Issues Published Annually: 6; 3B)Annual Subscription Price: $15.00; 6.)Name of Publisher: William P. Pala; Name of Editor: Deborah Borden; 7.)Owner: Amateur Radio Research and Development Corporation (AMRAD), P.O.Drawer 6148, McLean, Va. USA 22106-6148; 10.)Extent and Nature of Circulation: Average Number of Copies Each Issue During Preceding 12 months A.)Total Number of Copies Printed: 325; B.)Paid Circulation: 231; D.) Free Distribution: 1)Exchange: 15, 2)Complimentary: 35, 3)Honorary: 3, 4)Samples: 20; E.)Total Distribution: 304; F.)Copies not Distributed: 21.

TREASURER'S REPORT

Balance Sheet for AMRAD 1989: Income: $3,298, Expense: $2,873, Net: +$424. We bought a spectrum analyzer this year for use in the laboratory for $800 which is not shown under expenses above but as an asset. Total assets are $9,239; CDs $5,722 (Life member reserve fund); Checking $2,716; Property: $800 (only includes Analyzer at this time, repeater and computers not valued yet).

SHACK SALES

The following items are for sale:

TANDY Model 600 laptop computer, FDD, modem. $450.

Brother EP-44 laptop printer/typewriter/terminal, extra paper, ribbons, RS-232c interface (portable packet terminal). $125.

RADIO SHACK cassette stereo deck (never used). $25.

From the shack of Dave Rogers N4JGQ, P.O.Box 1835, Vienna, Va. 22183.

AMRAD MEMBERSHIP APPLICATION/RENEWAL

Mail to: Membership, AMRAD, P.O. BOX 6148, McLean, Va. 22106-6148

ANNUAL DUES: Regular $15; 2nd in family at same address add $8; Canada and Mexico add $2; foreign surface add $2.30; foreign air mail add $8; currency is US dollars. A donation to the WD4IWG/R repeater fund is appreciated if you use the repeater. Please make checks payable to AMRAD.

Name_____ Amateur Call_____ License Class_____

Street Address_____ App#_____

City_____ State/Prov_____ ZIP/PC_____

Country_____ Home Phone (___)____-_____ Work Phone (___)____-_____

Special Interest Groups: please indicate your interest.

__Deaf Communications __RTTY __Spread Spectrum __Packet Radio __Digital Signal Processing

Network: CompuServe ID:_____

_____ ID:_____

Packet Radio mail box _____ ARRL member?___

AMRAD

The Amateur Radio Research and Development Corporation (AMRAD) is a worldwide club of several hundred amateur radio and computer experimenters. It is incorporated in Virginia and is recognized by the U.S. Internal Revenue Service as a tax-exempt scientific and educational organization.

AMRAD's Purpose

The purpose of AMRAD is to: develop skills and knowledge in radio and electronic technology; advocate design of experimental equipment and techniques; promote basic and applied research; organize technical forums and symposiums; collect and disseminate technical information; and provide experimental repeaters.

Meetings

Meetings are on the first Monday of each month at 7:30 P.M. at the Red Cross Building, Merrifield, VA. If the first Monday is a holiday, an alternate date will be announced in the newsletter. Except for the annual meeting in December, meetings are reserved for technical talks - not business.

WD4IWG Repeater

WD4IWG/R is an open repeater for FM voice and digital communications, especially for experimental modes. It is located in McLean, VA. It features an autopatch available to licensed members. Frequencies are: 147.81 MHz in and 147.21 MHz out. The repeater director is Jeff Brennan, WB4WLW.

Westlink Report

The Westlink report is aired every Sunday night at 8:00PM on the WD4IWG repeater.

WB4JFI-5 Digipeater

WB4JFI-5 is a 1200-baud AX.25 Level 2 digipeater operating on 145.01 MHz. It is located in northwest Washington DC at Wisconsin Ave. and River Rd. The digipeater is mounted at an elevation of 350 feet on the south leg of the WUSA/WJLA TV tower.

Data Address

Our CompuServe/Micronet number is [72345,1050].

AMRAD Computer Bulletin Board System

AMRAD CBBS, (703) 734-1387, is operated by Lawrence Kesteloot, N4NTL. The system accepts calls at 300, 1200 and 2400 baud. The data path settings are 8 data bits, 1 stop bits, and no parity.

HEX Bulletin Board System

Handicapped Education Exchange is operated by Dick Barth, W3HWN. HEX accepts TDD/300 baud at (301) 593-7033,and 300/1200 baud at (301) 593-7357. ASCII is 8N1

Affiliations

AMRAD is affiliated with the American Radio Relay League (ARRL), Foundation for Amateur Radio (FAR), Northern Virginia Radio Council (NOVARC) and the Mid-Atlantic Repeater Council (T-MARC).

AMRAD Newsletter

The AMRAD newsletter is mailed six times a year to members and other clubs on an exchange basis. Technical articles, product announcements, news items, and other copy relating to amateur radio and computing is welcome. Honorariums of one year free membership are given for original material accepted. Maximum of one year per year. Classified ads are free to members. Commercial ad inquires are invited. The editor reserves the right to reject or edit any portions of the copy. Items should be mailed to Editor, AMRAD Newsletter, P.O. Drawer 6148, McLean, VA 22106. Full permission for reprinting or quoting items is granted provided that credit is given to both the author and the newsletter. Membership in AMRAD is $15 annually ($8 for second member of same family). Mailing to U.S. and possessions is by 3rd Class bulk mail. Canadian and Mexican addresses add $2 for postage. Overseas readers add $8 for air mail or $2.30 for surface.

AMRAD Officers for 1990 are:

André Kesteloot	N4ICK	President, Director	(703) 356-5519
Terry L. Fox	WB4JFI	Vice-President,Director	(703) 698-7621
Gerald Adkins	N4GA	Treasurer	(703) 538-6936
William P. Pala Jr.	WB4NFB	Secretary, Director	(703) 764-3710
David W. Borden	K8MMO	Director	(301) 859-0400
Jeffrey Brennan	WB4WLW	Alternate Director	(703) 698-7924
Elton A. Sanders	WB5MMB	Director	(703) 281-1298
John Teller	N4NUN	Alternate Director	(703) 938-5369

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